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Abstract

Scientific research is expected to contribute to enhancing human societies in various ways, ranging from enabling countries to compete in a knowledge economy, to providing solutions to pressing problems. This chapter examines the experience of Muslim-majority states to distinguish national, regional, and global perspectives on research governance. Actors involved across these three levels include public universities and research centres to train skilled professionals, ministerial meetings and international organizations to represent Islamic or Arab world science, as well as self-organizing scientists collaborating with peers abroad through bilateral agreements and funding opportunities. National perspective privileges domestic science, regional perspective privileges cooperation among predominantly Muslim states, and global perspective privileges links to science-leading locations anywhere. Arguably research governance has scaled-up, shifting from exceptionalism of science in the Muslim world, to become entangled with global science. Implications of this shift include a narrowing of research agendas onto shared 'global' challenges and a fragmentation of research effort across Muslim states.

Introduction

Recent years witnessed hope that a new golden age for science would spread across the Islamic world. Oil-exporting countries established research funds and built new universities as part of a shift towards a knowledge economy expected to be a future source of prosperity. Such investments evoke deep memories of the period before the European renaissance when Baghdad, Alexandria, and Fez were world centres of scholarship and research. King Abdullah University of Science & Technology, Hamad bin Khalifa University, and others have established themselves as modern-day hubs in the global network of science. Yet these places are simply among the more visible of ways Muslim-majority states govern how research is organized, performed, and intended to benefit society. For a broader appreciation of Muslim perspectives on research governance, one must consider the historical experiences of different countries stretching back before the 20th century, in most cases predating their emergence as modern nation-states.

As described in the introduction to the volume, governance is policy coherence around key issues and the responsibility for providing public good that emerges from cooperation and competition among rival sources of authority, including state and non-state actors (cf Rosenau 2002; Pal and Tok, this volume). Kooiman (2003:4) views governance as public and private actors working through institutional contexts for "solving societal problems or creating societal opportunities… and establishing a normative foundation for… those activities." In other words, governance encompasses how particular actors and channels use resources and exercise power to

order social phenomenon and human interaction, including the organization, function, and goals of institutional arrangements. In the literature, governance is often equated with state capacity, governments acting through the channels of providing services or behaving in accordance with citizen expectations (Holt and Manning 2014). Yet governance is not restricted to the formal intentions of government policy and bureaucracy. The actors and channels involved can emanate beyond government, and include private sector, professional associations, transnational movements, or international networks.

Research governance can be defined as the decision-making processes that determine priority setting, funding allocation, the management of research institutes, and the incentives for how researchers use their time and effort, including how their performance is assessed (OECD 2003). How research is conceived, produced, and transmitted to society involves forces emanating from within the scientific community and partially autonomous universities, as well as the actions or intent of government departments for science or funding agencies. In Western countries, there has been a historic shift, with research governance steering towards 'solving' societal problems and 'creating' economic growth through innovations and commercializing findings (Meyers and Kearnes 2013, Barros de Barros 2015).

By definition, Muslim-majority states are countries where more than half the population adheres to the Islamic faith. It is assumed that Islamic principles inform the approach to policy and governance in these places. Muslim-majority states form a largely contiguous geography stretching from West Africa to Southeast Asia, including Arabic-speaking countries, Turkey, Iran, Pakistan, Malaysia, Indonesia, and Senegal. Yet as elaborated throughout this volume, the

label is imprecise and ignores both diaspora communities from Muslim-majority states residing elsewhere, as well as Muslim-minority populations in other countries. An imperfect definition uses the membership of the Organization for Islamic Cooperation (OIC), yet it is daunting to generalize across such a diverse set of societies. Indeed, the OIC itself was established, not due to cultural or historic commonality among its member states, but in the wake of violence at Al-Aqsa mosque and fear of intolerance towards the faith.

The governance of research in Muslim-majority states, initially shaped by national governments, has scaled beyond state borders to become entangled with global science. Through this evolution, there were notable shifts in the actors and channels influencing the structure and aims of research effort, including what researchers choose to study and how their performance is assessed. In considering Muslim perspectives on research governance, this chapter employs a realist approach based on the historic experience of Muslim-majority states, rather than a normative approach elucidating distinct Islamic principles for governing knowledge and science.

One cannot ignore the contribution by generations of Muslim scholars to the intellectual development of modern science. Ibn al-Haytham pioneered a scientific method of observation, hypothesis formulation, and experimental testing, while Ibn Khaldun's treatise (al-Muqaddimah) on the rise and fall of states anticipated the fields of sociology and international development (Morgan 2007, Alatas 2013). Muslim-majority states are home to some of the oldest centres of higher learning: Zaytuna (733 CE), Qarawiyyan (859 CE), Al-Azhar (970 CE) and Al-Nizamiya (1039 CE) in modern-day Tunisia, Morocco, Egypt and Iraq. These institutions began as madrassas dedicated to scholarship of law and Islam, while pursuit of classic science from the

Greeks occurred separately at academies, observatories, and libraries. Madrassas sustained themselves through *waqf*, or private donations and endowments bequeathed for a particular purpose. Makdisi (1981) examines parallels between madrassas and the medieval university which emerged as a self-governed corporation sustained through charitable trusts. Makdisi credits the madrassas for inspiring the college system of students and instructors living together, as well as the integration of Aristotlian argumentation and oral thesis into scholastic practice. Muslim traditions in scholarship have even been cited as the genesis of the contemporary labels of "research chair" (Meri 2006, 457). Islamic higher learning was one source of inspiration at the origins and evolution of the medieval university (Dallal 2010, Alatas 2006), intermingled with monastic traditions and the emergence of student guilds. Further influence accompanied the transfer of scientific texts to Europe, following the Arabic translation movement in Baghdad and a golden age of Islamic science between the 10th and 13th centuries (Al-Khalili 2011, Saliba 2007).

National aspirations for domestic science

The first perspective views research at the service of nation-building of independent states. Under this perspective, governance is performed by the state, acting on national universities and public research centres, through the channel of training highly-skilled professionals, particularly in medicine, engineering, and agriculture.

The transformation of Muslim-majority states into modern nations varies from the early 20th century in the case to Saudi Arabia and Morocco, to the aftermath of World War II in the case of Jordan and Pakistan, to the 1960s and 1970s in the case of Malaysia and the United Arab Emirates (UAE) and Qatar. Notably Oman remained self-governing since the 18th century. These brief examples serve to highlight that no single narrative encompasses the diversity of historic paths witnessed among these states. Some emerged from periods under former monarchies or as foreign protectorates, while others simply cultivated greater reliance on domestic leadership as former empires faded. Tunisia, Egypt and Syria experienced multiple moments of transition. Yet despite this diversity, Muslim-majority states share periods when the activity of researchers, public research centres, and universities were seen as serving the cause of nation building, by providing skilled professionals and providing knowledge to modernize military army and state institutions (Zahlan 2012, Herrera 2007).

In many countries, modern higher learning was championed by what would now be called private institutions. Some were established by religious orders, to pursue an enlightenment mission independent of, or before, the modern state. Notable examples include the Syrian Protestant College (1866, later renamed American University of Beirut) and Université Saint-Joseph (1874). Even institutions that would later become national centres of higher learning started as private institutions such as the Egyptian University (1908) (subsequently renamed Cairo University), Université d'Algerie (1909), and the University of Damascus (1923). At their origins, these institutions combined individualistic and societal aspirations. At the individual level, they sought to transform their students into modern, enlightened leaders who would move their societies forward (Anderson 2011). At the societal level, they enhanced national proficiency

in agriculture, human and animal health, medicine, and engineering. Higher learning was not merely the means to an elite profession and the commensurate prestige and income, but also for skills and expertise required by nascent nations: fostering health care, expanding irrigation and rail networks, and establishing domestic legal and policy expertise.

Following the World War II, many Muslim-majority states dramatically increased access to public education. Across Arabic-speaking countries enrolment expanded from just 30,000 in the 1930s to over five million by the 2000s (Mazawi 2005), growing from an initial 3 per cent to reach 20 per cent of eligible youth. Expanding enrolment was made by possible by growth in the size and number of public universities, and through policy support for mass education between 1950s and 1980s to replace expatriate professionals with homegrown expertise. Yet as public degrees became more common, the 1990s and 2000s witnessed a new wave of private higher learning. Across Arabic-speaking countries, the number of universities expanded from 20 in 1960, to 47 in 1975, to reach 184 by 2003. In Indonesia, enrolment in higher education quadrupled over two decades, from 1990 to 2010 (Rakhmani and Siregar 2016).

One aim behind these developments is to build domestic talent in the form highly-qualified personnel able to realize national development plans envisioned by government leaders. Emphasis tends to be on training and knowledge generation in the natural sciences, particularly agriculture, medicine, and engineering. Such fields are valued by policy leaders for their promise to transform the nation's resources and to master technologies needed to enhance the wealth and well-being of citizens. Law, economics, and political science also enjoy pragmatic support for their potential to create social order and optimize the use of scarce resources. In short, one aim of

governance is to create inputs needed for physically transforming Muslim states into the built environment and services envisioned for their future.

Beyond these pragmatic aims, education and research also foster a sense of national identity. The boundaries of many Muslim-majority states, shaped in part through expansion and collapse of former empires and colonial powers, gather together people from multiple ethnic groups. National curricula, universities, research centres, libraries and publications foster a sense of academic and professional community that symbolize state sovereignty (Zahlan 2012, Herrera 2007). This sense of national identity plays into the narratives of citizenship, encouraging youth to identify with the nation rather than with tribal and kin identity. Some countries treat professors and researchers at public institutions as civil servants, with strong state control over university and public research administration. In comparison to European countries, such as Germany or France, Muslim-majority states afford such institutions little autonomy in their management. For example, the appointment of research directors and academic posts are commonly decided by or require the acquiescence of state officials.

In summary, a national perspective of research governance works through the actors of national universities and public research centres, including the state bureaucracies that manage these organizations. The channels through which governance is exercised is the formation of professionals, including their accreditation and employment prospects, especially during periods when the public sector is a key employer of such people. Research is valued for its contribution to state sovereignty and nation building, providing the skills and technologies required to realize national development plans, as well as providing a sense of national identity.

Regional collaboration among Islamic countries

The second perspective views research as a means of reinforcing the regional identity among the *Ummah*, people who share the Islamic faith. Under this perspective, governance is performed by ministerial coordination, acting on regional organizations, through the channels of international programs for scholarships, professional exchanges, and mutual support. The League of Arab States and the Organization of Islamic Cooperation include a number of arrangements relevant to research governance.

Created in 1945, the Arab League has 22 member-states stretching across North Africa and the Middle East, including the entire Arabian peninsula as well as Somalia. The Arab League reflects the historic moment of its creation, both in mirroring the organizational structure of the United Nations, and with its headquarters based in Cairo, given the then-prominent position played by Egypt in shaping international relations among Muslim-majority states. The Arab League Educational, Cultural and Scientific Organization (ALESCO) was created in 1970 and, analogous to UNESCO, fosters scientific cooperation among its member states. Located in Tunis, ALESCO also has its offices in distinct location from the organization's headquarters. Similarly the League established an Association of Arab Universities in 1969 based in Amman. From the 1950s to the early 1970s, the Arab League and subsidiary organizations flourished in part due to the weight and influence of Egypt under presidents Gamal Abdel Nasser and Anwar Sadat, positioning Cairo as a vital hub within international affairs. The Arab League served as a multilateral space in the geographic centre of the Muslim world, perceived as counterbalancing

the United Nations but without the presence of outside world powers. While the Arab League continues today, the 1970s and 1980s witnessed the creation of new fora that captured the attention of member states and diminished the League's relatively importance and convening power.

The Organization of Islamic Cooperation (OIC) was founded in 1969 with the intent of serving as the collective voice of Muslim-majority states. The catalyst for its creation lay in the fate of the al-Aqsa mosque in Jerusalem, the third holiest site in Islam. Jordan lost control of the mosque following the Six-Day War in 1967, and two years later the mosque was damaged in a fire deliberately started by non-Muslim visitor. The creation of the OIC served to encompass a wider range of states beyond the Arabic-speaking world, extending from West Africa to Southeast Asia. In the late 1970s and early 1980s, the OIC established its own subsidiary organs including the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) in Ankara, the ministerial standing committee on scientific and technological cooperation (COMSTECH) in Islamabad, and the Islamic Educational, Scientific and Cultural Organization (ISESCO) in Rabat. The creation of the OIC reflected a shift in financial and political power among Muslim-majority states, most notably the rise of the Gulf states driven by petroleum revenue from the dual oil crises in the 1970s, and consolidated with the creation of the Gulf Cooperation Council in 1981. Yet the OIC also thrived as Iran, Turkey, Malaysia, Pakistan and Nigeria became regionally important powers in their own right. OIC membership expanded in the 1990s with the addition of countries in Central Asia, including Azerbaijan, Kazakhstan, and Uzbekistan.

Thus Muslim-majority states created new actors and channels for scientific collaboration among themselves. Both the Arab League and OIC spawned specialized agencies and ministerial meetings on science cooperation, in part as an alternate to UNESCO and other intergovernmental fora. Beyond simply avoiding engagement with Western powers, these Muslim-centred fora provided their members the opportunity to further their own agenda, including the Arabization of teaching curricula in 1960s, the expansion of mass education in 1970s, and the promotion of exchanges and collaboration among scholars and scientists within Muslim-majority states. By directing their energy to such fora, Muslim-majority states intentionally sought to strengthen ties among the *Ummah* as an international community based on faith, and perhaps unintentionally weakening United Nations-led channels of international scientific cooperation.

Regional cooperation initially built on the promise of pan-Arab unity, echoing the historic ties from the Ottoman Empire and Arab revolt of the early 20th century. Yet the League of Arab States is limited by both membership, excluding Iran and non-Arabic speaking countries, as well as by the League's Charter, which defers to state sovereignty and offers only weak regionalism (Valbjørn 2016). The attractiveness of this vision faded in the wake of the 1967 war, and increased competition from other fora for time and attention. Previously the centre of research across the Arab world, regional power began to pivot away from Egypt in the 1970s as other Muslim-majority states (particularly Saudi Arabia) grew in prominence and forged their own paths in higher education and research policy.

The OIC reflects this shift, with its headquarters in Jeddah, and scientific agencies based in Turkey, Pakistan, and Morocco. Yet the OIC also defers to the sanctity of state sovereignty, and

has been described as “more symbolic meeting place than a dynamic political body” (Ahmad 2008). The OIC specialized agencies are limited in power and resources. For example, COMSTECH awarded a total of six million dollars in research grants over two decades (Jan et al. 2016). OIC implicitly competes for member-state attention and funding with other overlapping regional fora -- including for science and research cooperation -- including the African Union, Gulf Cooperation Council, Shanghai Cooperation Organisation, South Asian Association for Regional Cooperation (SAARC) and the Association of Southeast Asian Nations (ASEAN). Beyond the OIC umbrella, an Islamic World Academy of Sciences (IAS) was established in 1986 under royal patronage of Pakistan and Jordan.

Despite these limitations, patterns of research collaboration emerged. Hassan et al (2016) analyze data from Scopus on scientific publications in between 1996 and 2010, and identify Turkey and Iran as the most productive OIC member states with 110,000 and 80,000 papers respectively. A second tier of OIC members includes Malaysia, Egypt, and Pakistan ranging between 40,000 and 20,000 papers. These are followed by Saudi Arabia, Nigeria, and Tunisia, which each produced around 15,000 papers. Algeria, Morocco, and Indonesia produced 10,000 or fewer papers. Examining co-authored scientific publications, Hassan et al (2016) also identify three clusters of collaboration within OIC: the most pronounced is centred on Egypt and Saudi Arabia, followed by another centred on Malaysia and Indonesia, and finally one among countries in Equatorial Africa. Other notable patterns include Turkey-Azerbaijan, and collaboration among Algeria, Morocco, and Tunisia. With the exception of joint Saudi Arabia-Egypt or joint Indonesia-Malaysia co-publications, collaboration with other OIC countries accounts for less than six per cent of any member state’s total production, even when overall international collaboration ranges

between 20 and 40 per cent of overall production. For example, even the scientific powerhouses of Turkey and Iran co-publish less than two per cent of their production with OIC co-authors. The outlier is Saudi Arabia, which in 2010 had one-third of its publications co-authored with OIC members.

In summary, a regional perspective works through the actors of specialized agencies and ministerial-level fora under the Arab League and OIC. The channels through which governance is exercised include promotion of exchanges and research collaboration, aided by modest grants for projects and student mobility. Such efforts are predicated on a sense of common identity among Muslim populations, initially among Arabic-speaking countries and now stretching from West Africa to Southeast Asia. The shift from the Arab League to the OIC recognizes the broader geography of Muslim-majority states and the rising influence of different regional powers, particularly Saudi Arabia. Research is valued for its contribution to regional cooperation and providing an opportunity for weaker states to draw on the scientific proficiency of more advanced ones. The Arab League and OIC eschewed engagement with Western powers and the United Nations, yet face competition from overlapping fora for cooperation in Africa and Arabia, as well as in Central, South, and Southeast Asia.

Connecting to global networks of science

The third perspective views research as engagement with globalization to secure a role in the advances and benefits of modern technology. Under this perspective, governance is performed by research funds and science hubs, acting on individual researchers and teams, through the

channels of priority setting and international collaboration. In pursuing their careers, researchers are expected to connect to the global network of science, and through those linkages create benefits for local society.

The advent of the Internet and expansion of air travel routes made it increasingly feasible to contemplate and pursue research collaboration farther afield that merely in adjacent countries or those with a shared culture and language. Europe and North America in particular have drawn students from across Muslim-majority states, more recently accompanied by China and Southeast Asia as major destinations. Patterns of research collaboration have been described as self-organized networks, where researchers choose their own peers and projects (Wagner 2008). Researchers collaborate in order to share funding, data, facilities, and talent, whether their own skills or those of jointly-supervised graduate students. They also partake in collaboration as a means to assemble experience towards a longer-term career or research program (Shove 2003) or as a response to incentives and performance expectations within their home organizations.

Research funders also promote collaboration by encouraging work to address large-scale societal challenges, and gearing research evaluation to include ex ante assessment of potential for "impact" (Whitley and Gläser 2007). The political economy surrounding public research funding requires grant-seekers to demonstrate both academic excellence and societal relevance. Simultaneously, a growing number of private universities opened after 1990 in Muslim-majority states, and began to displace the public university mission of "citizen building" with a logic of private education motivated by "economic rationality" (Herrera 2007). Whereas a previous generation sought entry to a domestic professional class contributing to national development,

today's students and their parents are motivated to seek skills perceived as being in high demand within labour markets.

Research collaboration is drawn to scientifically-proficient places, particularly hubs within advanced economies, such as leading research universities. While the novice university student may desire to study abroad in the UK, USA, France, Canada, or China, the young research professional will single out particular institutions and senior researchers with whom they wish to collaborate, such as the London School of Economics (LSE), California Institute of Technology (Caltech), Science Po-Paris, University of Toronto, or Tsinghua University. For example, Saudi Arabia's top research collaborators are the USA, China, United Kingdom, Germany, and Canada, rather than with other Muslim-majority states. Indeed, within-OIC collaboration is relatively weak compared to collaboration between a OIC member and either the European Union or ASEAN (Hassan et al 2016). Such ties are also encouraged by numerous scholarships and research funds within Muslim-majority states, such as the King Abdulaziz City for Science & Technology, as well as funding programs such as the European Union's Horizon 2020 and the United Kingdom's Newton Fund.

Beyond the individual incentive of funding opportunities and career incentives, the logic underpinning global research collaboration is to tap into world-leading teams and generate local benefit. Patterns of global research collaboration are reinforced by concentration of talent and funding, and editorial preference among academic journals for research focused on more global phenomena of interest to a wide readership (Hanafi and Arvanitis 2016)[1]. Whereas a national

[1] Consequently, researchers face a significant barrier in trying to publish work focused on very local phenomena perceived to be of interest to a limited readership. Researchers recount rejection letters from journals citing the

perspective on research collaboration seeks to increase the prestige and ranking of a domestic university or research centre, a global perspective on research seeks to connect national researchers to centres of excellence abroad to address domestic needs. Whereas one perspective encourages national communities of professionals to produce domestic publications in local languages, the other perspective encourages its citizens to participate in global science and publish in prestigious journals with international readership. Global collaboration is easily pursued in the natural sciences such as mathematics, engineering, and medicine. These fields of knowledge are underpinned by phenomena and theories focused on the physical world or human physiology, largely independent of the culture, laws, and traditions of their country of application. Slightly more nuance and respect for local specificity are required in other natural sciences such as architecture, agriculture, and economics. These fields also rely on universal body of knowledge, yet variation in culture, history and climate are significant and influence the solutions people seek from science.

Social sciences and humanities are also amenable to global collaboration, such as education, sociology, and political science. Yet research collaboration in these fields is more often comparative in design, examining particular phenomenon in diverse settings even if applying similar methods. Even the fields of Islamic studies or Islamic finance, at first glance uniquely rooted in Muslim-majority states, link to global scholarship on law, jurisprudence, and economics. Such subjects distinguish themselves by fields articulating and incorporating certain principles and values, but do not reinvent the sciences from first principles. Much of the theory

narrow focus of their work rather than its scientific quality. These letters include encouragement to expand the work to include a wider range of study site or case studies, yet this can exceed the time and resources available to local researchers.

and insight on finance remains relevant for the scholar of Islamic finance. Scholars of public policy also share common ground in the ideas, concepts and methods contained in the academic literature, regardless of differences in society and social norms. Lamentably, many Muslim-majority states have actively discouraged social sciences. Governance in Muslim societies is understudied, with existing work focusing on managerial and policy literature, largely ignoring issues of language, state bureaucracy, and class (AlMaghlouth et al. 2015, Amin et al. 2012, Mazawi 2005). Multiple states censor publications, require permits or security clearance for conducting surveys and collecting data, and place restraints on freedom of movement and expression by intellectuals, as well as the receipt and use of foreign funding (Bamyeh 2015, Jacquemond and Selim 2015, Anderson and Djeflat 2013, Herrera 2007).[2] Ironically the repression of critical social science itself inspires international collaboration as researchers turn to networks outside their countries for support and funding unavailable at home.

Beyond merely connecting to distant hubs of science, a number of Muslim-majority states have sought to establish themselves as hubs or anchors within global research networks. The King Abdullah University for Science and Technology (KAUST) in Saudi Arabia is based on the California Institute of Technology model of small, focused research teams (Sarant 2016). Education City in Qatar functions as a single campus that groups together teaching programs in such fields as engineering, medicine, journalism, foreign policy, and computer science offered through local branches of Texas A&M, Weill Cornell, Northwestern, Georgetown, and Carnegie Mellon. Elsewhere Muslim-majority states seek to distinguish themselves within global science, for example Senegal is working with the World Bank to identify centres of excellence enabling

[2] Also see www.al-fanarmedia.org

different African countries to specialize in particular subjects (UNESCO 2015). Muslim-majority states participate in the Global Research Council, a virtual organization linking research granting councils to foster multilateral research and collaboration across continents. Funding organizations from Saudi Arabia, Qatar, Kuwait, Oman, Morocco and Malaysia have played a convening role in the Middle East/North Africa and Asia-Pacific regions. To date, the Global Research Council has adopted common standards and principles on merit review, open access, and research integrity. Through such consensus, the Global Research Council is enhancing opportunities for interoperability and joint calls for research on common priorities, along the lines of those by G8 Research Councils' multilateral initiative or the Belmont Forum of funders on environmental change research.

In summary, a global perspective on research governance works through the actors of research hubs and funding organizations. The channels through which governance is exercised are international collaboration arising from scholars and researchers reaching out to peers abroad, government negotiating bilateral science and technology agreement with other countries, science ministries identifying national research priorities, and funding competitions to sponsor work on these priorities. Such efforts aim to connect countries to global networks of science, to both ensure a nation's leading scientists participate in those networks and to derive national benefit from the research performed within them. Whereas a national or regional privileges domestic capacity or ties among Muslim-majority states, a global perspective privileges links to science-leading locations and seeks to strengthen one's standing in global networks.

Discussion

The national, regional, and global perspectives on research governance offer one means of distinguishing among the policies pursued and investments made by Muslim-majority states. These three perspectives do not necessarily succeed one another in historical sequence, but rather co-exist over time, coming to prominence with the rise and fall in the influence of different actors and channels. Cooperation under the auspices of the Arab League and OIC continues to exist, even as the contemporary influence of these fora is limited. Meanwhile, member states seek to build their national capacity while actively working with other funders on the global stage. It is tempting to assign historical dates to define periods of time when different perspectives are dominant. This is feasible for individual countries, yet no generalization can be made across the contemporary history of the entire Islamic world. Moreover, beyond arguing whether a single perspective holds sway during a particular time and place, richer insight emerges from studying the competition among perspectives, and the actors and channels that embody them.

A national perspective is championed through public universities and research centres, including the state bureaucracies that manage these organizations. The channels through which governance is exercised is the formation of professionals, including their accreditation and employment prospects. A regional perspective works through the actors of specialized agencies and ministerial-level fora under the Arab League and OIC. The channels through which governance is exercised is promotion of exchanges and research collaboration, aided by modest-sized grants for projects and student mobility. A global perspective involves contemporary research hubs and funding organizations. The channels through which governance is exercised include self-

organized connections to peers abroad, bilateral science and technology agreements, and the identification of national research priorities intended in part to attract the attention of global talent.

The perspectives on research governance matter because they inspire real-life actors and their decisions in working through channels that control the use of financial, human and scientific resources. As noted by Beland and Cox (2011) "what things change and how they change are all the result of what people choose to do... these choices are shaped by the ideas people hold and debate." The question of transition between perspectives is not simply when do ideas change, but rather when are particular actors and channels more powerful in shaping policy, investing in scientific capacity, and influencing how scientists use their time and effort. Conversely, ideas on research governance are largely irrelevant if they fail to impact at least one of these realms of policy, investment, and researcher choice. Transition between perspectives can thus be punctuated, such as the creation of Qatar's National Research Fund in 2006, or more gradual, such as the fading prominence of ISESCO over decades.

With the succession of actors and channels, research governance scaled up from the national to the global level. Historical and contemporary patterns of mobility and migration across the Islamic world accentuate this shift. For example, the flow of people and ideas between Tunisia and France influenced approaches to teaching and the organization of research activities in Tunisia. Similarly, collaboration between Morocco and Quebec stems from the presence of diaspora scientists maintaining and cultivating opportunities to work with colleagues or former graduate students back home. The varied patterns of sending and receiving areas for international

students and migrant researchers warrants greater analysis than can be afforded here. Suffice it to say that patterns of international cooperation can be explained in part by nationality, identity, and the degree of closeness felt among potential collaborators. Historic ties and diaspora communities link a country to distant global centres. Even in pursuing a national perspective, Muslim-majority states can further global connectivity through ties to citizens and kin abroad.

In scaling up from the national to the global level, research governance shifted from exceptionalism of science in the Muslim world, to become entangled with global science. One implication of this shift is a narrowing of research agendas on shared societal challenges. A national perspective seeks to build research capacity at home, establishing and growing domestic institutions including public universities and research centres. Invariably the creation of national institutions takes on some of the character and idiosyncrasy of the society to which they belong. The Agricultural Research Center in Egypt and the Pakistan Agricultural Research Council serve as hubs for homegrown communities of agricultural specialists, with relatively limited flows of talent in-or-out of the country, focusing on local crops and climates. Moreover, each of these professional communities has developed its own norms and practices, which in turn influence the daily work of its members. In contrast, a global perspective seeks to tap into research capacity abroad, connecting to world-leading talent and attracting its application at home. The measures of "going global" are often simplified as publishing or co-publishing internationally in highly-cited journals. Nonetheless, the underlying motivation is to create value for the home society, such as tapping outside expertise to create more sophisticated and useful knowledge than could be created by the domestic research community working in isolation. For example, the emergence of a novel pathogen quickly triggers recourse to the World Health Organization and

international networks to rapidly sequence the pathogen's genetics and search for possible candidates for treatment and vaccine development.

The "global" in "global governance" refers to the level at which actors engage, and not merely to public goods that only exist at that level. Global phenomenon include mitigation against climate change, standards for interoperability of communication technologies, and the stability of the international financial systems. Other phenomenon exist primarily at the regional, national, or local levels, yet have emergent properties that exist at higher levels that necessitate scaling up to global governance. Examples includes health systems to control infectious disease, managing watercourses and coasts, and law enforcement and counter-terrorism. The crafting of global governance for such goods or services coordinates across the delivery of public value at lower levels within different jurisdictions. Conversely, global-level governance may also seek to compensate for the failure to provide such public value at lower levels. Within research governance, tentative steps towards international joint calls for proposals are an attempt to solve a coordination failure under the status quo in which different nations mount different parallel funding competitions for the domestic scientific community, providing insufficient incentive for international collaboration. Simultaneously, international funding programs provide new opportunities for researchers in otherwise disadvantaged countries with limited domestic support for science.

The manner in which states pursue shared societal challenges has inadvertently fragmented research effort among and within Muslim-majority states. For example, countries across North Africa and the Middle East have identified similar lists of national research priorities, including

generating renewable energy, improving water security, and preventing non-communicable diseases. Yet these same countries mostly ignore opportunities to work with neighbours within the region or elsewhere in the Islamic world, preferring instead to compete independently in courting world-renowned scientists and research hubs in Europe, the Americas, and Asia. The result is an unintentional fragmentation in research effort, the duplication and isolation of separate efforts to address common societal challenges. In short, Muslim-majority states lurched from emphasizing exceptionalism to fostering fragmentation. The race to collaborate with science-leading places has positioned Muslim-majority states to compete with each other in a manner that fragments research effort between countries and disciplines.

Despite clear interest in the potential for research to address societal challenges, the manner in which science is organized in Muslim-majority states has maintained barriers between academic disciplines and professional communities. There is a clear opportunity to enhance interdisciplinary approaches to societal challenges, encouraging researchers to bridge differences in ontology (unit of analysis) and epistemology (how to establish validity, nature of explanation). For example, there is no shortage of research centres on agriculture across Muslim-majority states, yet there is scarce expertise in food security capable of linking changes in field-level production, industrial processing, and public health outcomes. Pursuing interdisciplinarity requires creativity, interpersonal and intercultural skills, competences that are also required to succeed in engaging with global science networks. As an increasing number of students and researchers are exposed to the emerging norms of global science, these competences will slowly become encoded into future professional practice. There are hopeful signs thus is already occurring, particularly in global-minded hubs across the Islamic world. For example, multiple

Muslim-majority states have joined the Global Research Council and agreed to its shared standards and principles. Moreover, participation in international collaboration, such as projects under the European Union's Horizon 2020, implicitly requires researchers to agree on how to share data, coordinate their activities, and disseminate findings.

Today's generation of young researchers not only have a global perspective, but might yet lead Muslim-majority states to better address global problems. As societies actively redefining themselves in the 21st century, Muslim-majority states have the opportunity to improve upon the changes in governance of science in OECD countries. These changes include a rise of competitive project funding alongside recurrent block funding, incorporating policy goals into science policy, new public management approach to governing higher education, and encouraging commercialization of publicly-funded research findings (Gläser and Laudel 2016). How these changes were implemented affected research content through the "impact of" specific arrangements on how researchers behave, as well as the "impact on" the construction of scientific knowledge. The sum of these changes have been critiqued for narrowing the research agenda in OECD countries and limiting opportunities for curiosity-driven research. Whether intentionally or not, Muslim-majority states encourage which types of science are pursued through the crafting and refining of their approach to research governance. Reflecting on experience elsewhere suggests an opportunity to balance national, regional, and global perspectives: fostering domestic talent, intellectual diversity, and open science while , creating incentives for addressing shared societal challenges and engaging in global collaboration.

Conclusion

Muslim-majority states pursue three distinct perspectives on research governance, embodied by different actors and channels. Under a national perspective, research is valued for its contribution to state sovereignty and nation building, providing the skills and technologies envisioned by national development plans, as well as providing a sense of national identity. Under a regional perspective, research collaboration seeks to strengthen a sense of common identity among Muslim populations, whether among Arabic-speaking countries or the broader community stretching from West Africa to Southeast Asia. Research is valued as a means of cooperation between weaker states to draw on the scientific proficiency of more advanced states. Under a global perspective, the aim is to connect countries to the global networks of science, to both ensure a nation's leading scientists participate in those networks and to derive national benefit from the research performed within them.

These perspectives mirror the historic experience of many Muslim-majority states and reflect wider changes in international relations, including a pivot from Egypt to the Gulf and the rising influence of regional powers beyond the Arabic-speaking region. Research governance scaled up from the national to the global level, due to shifts in the actors and channels governing how researchers allocate their time and effort. Whereas a national or regional perspective privileges domestic capacity or ties among Muslim-majority states, a global perspective privileges links to science-leading locations and seeks to strengthen one's standing in global networks. Transition between perspectives occured through changes in the actors and channels that shape policy, invest in scientific capacity, and influence what researchers choose to study. Once characterized

for the exceptionalism of science in the Muslim world, today there is fragmentation of the research community among and within Muslim-majority states. The global perspective to research governance brought an unintended narrowing of the research agenda, as different countries independently seek to solve societal 'challenges' while largely ignoring the incentives that continued to inhibit collaboration across organizations, borders, and fields of knowledge.

Moving forward, Muslim-majority states have an opportunity to balance the three perspectives to connect across countries and disciplines. Beyond formal agreement on principles and standards such as merit review and open access, there is a nascent consensus on the norms of global science such as striving for international publication, collaborating with peers abroad, and the need for interdisciplinary approaches. Slowly these norms are encoded into research practice, whether through the experience of diaspora researchers abroad, the mobility of graduate students, or highly-talented domestic researchers participating in international collaboration.In crafting and refining their approach to research governance, Muslim-majority states will encourage what type of science are pursued and what forms of activity are recognized and rewarded. Beyond merely engaging in global collaboration, rebalancing research governance requires creating incentives for working across different organizations and disciplines to address shared societal challenges,. Doing so will aid Muslim-majority states to establish more inclusive and innovative institutions needed to ensure the future of their societies.

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